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# ENVIRONMENTAL CHANGE-INDUCED CORAL DEGRADATION IN INDIA

- Implications for Human Security -

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## Environmental Change-induced Coral Degradation in India: Implications for Human Security

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India, being one of the most ecologically diverse countries in the world, is at the same time considered one of the most vulnerable countries, in relation to the adverse effects of climate change. One of the most threatened bio-geomorphologic features of India is its coral reefs; which are increasingly being affected by rising surface sea temperatures, ocean acidification and other direct/indirect impacts of global warming induced climate change. India is home to both fringing reefs (around the islands in the Gulf of Mannar, Gulf of Kachchh, Andaman and Nicobar Islands) and atolls (Lakshadweep). With the gradual unravelling of the geophysical cum geochemical impacts of climate change on these reefs, the security implications – especially on



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human security – are hard to ignore in a highly uncertain period, called nonetheless as the *Anthropocene*.

## **The Impact of Climate Change on the Coral Reefs**

In simple terms, coral reefs are the marine equivalent of tropical rain forests. Just as the latter acts as a control room for global precipitation patterns, coral reefs constantly police fluctuating sea level changes across low lying coastal terrains. These, in fact, protect the coastal populace from strong storm and tidal surges; thus preventing denudation and subsequent inundation of adjoining landforms from the vagaries of nature's fury.

Corals are invertebrate marine organisms possessing a hard exoskeleton made of calcium carbonate. Normally, reef-building corals share a symbiotic relationship with certain single-celled photosynthetic algae called zooxanthellae. The corals shelter the algae in their tissues and supply them with the requisite compounds for photosynthesis. In return, the algae absorb the sun's heat and produce oxygen, which facilitates the removal of coral waste material. In the same way, oxygen helps in breaking down glucose into carbohydrates. Corals indeed use these carbohydrates to synthesise the calcium carbonate in its exoskeleton; thereby making it sturdy and strong.

Salinity and warmth are two indispensable components for the survival of corals. This is the reason why all coral reefs and atolls are located along the warm shallow waters of the tropics and subtropics. However, when [sea surface temperatures](#) rise as a result of global warming or other phenomena, even the corals start feeling the pinch. Accordingly, the extra heat induces thermal expansion in the corals. Due to the underlying stress, the corals tend to surpass its elastic limit and begin to fracture. This weakens the exoskeleton base and it eventually withers away. But more importantly, the continued expansion and stress causes the zooxanthellae to break off from the coral. Now, the separated alga performs its functions in isolation from the coral. As a consequence, the corals lose its colour pigments and turn white. In purely scientific terms, they get bleached.

Apart from rising sea surface temperatures, [ocean acidification](#) (triggered by factors including climate change induced alterations in the ocean's chemistry) further expedites coral bleaching. In this case too, acidic sea waters delay the calcification rate of the coral exoskeleton. A third and not-so-discussed source of coral reef destruction is the increasing frequency of tropical hurricanes and thunderstorms, exacerbated by climate change. As storms accrue, because of the unchecked surface run-off of rain water into reefs, the already weakened and bleached coral exoskeleton



gets withered away. Unlike rising sea surface temperatures and ocean acidification (both of which chemically bleach the corals), the third one is more or less characterised by a physical degradation of coral reefs.

### **Implications of Degradation of Coral Reefs for the Lakshadweep Islands**

The Lakshadweep archipelago consists of [36 tiny islands](#), 12 atolls, 3 reefs and 5 submerged banks, covering an area of 32 square kilometres, with lagoons occupying about 4200 km<sup>2</sup>. Since they are only a few metres above sea level, they are highly vulnerable to sea erosion and storms, not excluding sea level rise. Worldwide, the case of the Maldives is discussed, taking into account the challenges posed by environmental and climatic changes to the country, especially to its corals. The case of the Lakshadweep islands is no different, since both are morphologically similar.

In 2010, intense coral bleaching activity was recorded across the atolls surrounding the [Agatti Island](#) in the Lakshadweep archipelago. During the months preceding the onset of the southwest monsoons (which usually makes landfall around the last week of May, or first week of June), the sea surface temperatures had risen to hitherto unprecedented levels. Ostensibly, the sea surface temperatures that year peaked to an alarming 34 degree Celsius, with a maximum aggregate of 32.5 degree Celsius. This delayed the arrival of the monsoon rains, which concomitantly led to prolonged thermal expansion and the inevitable bleaching of corals.

Let alone climate change, the reefs are being threatened by a number of other [human-driven factors](#) – such as ocean pollution caused by discharge of waste and fumes from shipping vessels and ferryboats, sedimentation, increase in waste generation due to population pressure, overexploitation of fisheries, coral mining, dredging, and the loss of natural vegetation owing to construction activities among other things. The irony is that the island's population is dependent on the reef resources for building materials.

The islanders' livelihood security and food security are directly linked to the sustainability of the reefs. The coral fauna is known to shelter [105 species divided among 37 genera](#). On the one hand, there is a significant population whose main occupation constitutes reef fishery, gleaning and other subsistence and small-scale activities. And on the other hand, reef fishing and gleaning provide the requisite proteins, particularly among the poor households. During the monsoon season, when the fishermen are not able to venture into the open sea, the island's population more or less thrives on the fish catch from the reefs – since agriculturally, only [coconuts](#) are farmed on these islands.



The coral bleaching surrounding the islands (that occurred in [1998](#)) destroyed 90 percent of the reefs. Meanwhile, according to reports, the relatively speedy recovery of reefs was not tantamount to the recovery of long-lived species like groupers, which perished due to the destruction and/or instability of their habitats. Similarly, the 2010 coral bleaching around the Agatti Island led to a drop in the fish catch in the reef lagoons, affecting both livelihood and food security. Indirectly, coral destruction has also impacted the [tuna fishery](#) – the primary economic activity on the island. Catching live bait for the tuna fishery adversely impacts the reefs. This in turn leads to a reduction of the live bait, thereby affecting the mainstay of the Lakshadweep economy. In short, depleting fish stocks associated with coral reef destruction can directly tamper with the human food supply system and the economy.

Since coral reefs act as natural wave breakers and also as regulators of sudden tidal swells, their destruction can have adverse consequences for the human populace inhabiting the low-lying coastal areas. First, there would be infusion, or in specific terms, intrusion, of saline water into the underground fresh water aquifers; followed by gradual submergence of the lowlands. In such a scenario, people would get displaced, their property destroyed and their dwellings would turn unliveable. Their resettlement and rehabilitation becomes an added burden on a country like India.

The most important factor that adds to the pressure on the coral reefs is the increasing population. More and more construction materials would be required for building the infrastructure. Moreover, with the increasing population density, garbage and sewage disposal/management becomes a huge problem – ultimately leading to coral degradation. Besides, several reports indicate that there already is a great amount of stress on the available groundwater resources due to [population pressure](#). Poorly managed groundwater extraction and the above-mentioned activities (that trigger saline water intrusion) have aggravated the situation further.

Judging by the current rate at which the environment is changing (that includes global warming), a recurrence of the 1998 and 2010 scenario is very imminent. The reefs may not be able to recover from such major El Niño Southern Oscillation-related coral bleaching events all the time. With the lingering possibility of similar bouts of coral bleaching over the coming years, Lakshadweep faces several challenges, including the potential threat of transgression from the rising seawaters – if not in the near future, at least in the long run. And as a consequence, if the islands become unliveable, migration (gradual or abrupt) is an issue that the Indian establishment will have to deal with.

## **The Question of Migration**





In popular literature concerning climate change, the term ‘climate refugee’ continues to find a place in the discourse; while in policy (particularly in countries such as India), the term is not quite popular (not even acceptable). Even while talking about potential migration from Bangladesh owing to climate change, sea-level rise and the loss of land, the Indian position has traditionally been pinned on socio-economic and political problems in the country rather than environmental ones. The degree and scale of uncertainty involved in climate modelling and predictions have given room for the Indian establishment to sideline this issue.

The issue is indeed less likely to affect the country in the short or medium term. But what the country cannot afford to do at this stage, is to neglect long-term impacts (first or second order) of environmental change. India was struck by the vagaries of climate change in the 1990s. What had ensued was astonishing, but at the same time shocking. The island of Lohachara, inhabited by 10,000 people was washed off the map; but this was confirmed by a group of Indian scientists only in 2006. The island lay in India’s part of the Sundarbans. There are conflicting reports as to how this might have occurred. It might be easier for everyone to pin the blame on global warming and sea level rise, which is why [most reports](#) readily claimed that this was the first time that an inhabited island had become a victim of global warming and the rising sea levels. Another incident in South Asia that grabbed the headlines was the submergence of the [New Moore Island](#), which both India and Bangladesh claimed as its territory, in 2010. Many commented dramatically that the rising sea water resolved the dispute between India and Bangladesh. However, many experts discard these claims and consider [poor dredging](#), changes in river dynamics and even eastward tilt of the tectonic plate as potential causes for the vanishing of Lohachara. Interestingly, in 2007, a group of scientists using satellite images and on-the-spot surveys revealed that the submerged [Lohachara and Bedford](#) islands are re-emerging.

The fact of the matter is that whether or not climate change caused the disappearance of these islands and whether this submergence was temporary or permanent, environmental change is triggering unpredictable events that the country needs to be prepared for. This includes possible migration from different endangered islands, such as Lakshadweep, to the mainland. The local island communities will then have to move away from their traditional habitats and livelihoods.

### **Coral Management as a Priority**

The Indian authorities have taken several steps to protect the reefs of Lakshadweep islands. However, most of what was initiated has sadly been hampered by various bureaucratic constraints. For instance, the Wild Life (Protection) Act of India (1972) had stressed on the establishment of [National Marine Parks](#), particularly allocated



for protecting coral reefs, among other sensitive and vulnerable marine flora and fauna. Subsequently, three areas were earmarked under the initiative: the Gulf of Kutch Marine Park (off the western coast of Gujarat), the Wandoor National Marine Park (in the South Andamans) and the Gulf of Mannar Marine Park (off the coast of Southeast Tamil Nadu). These parks are managed separately by the respective wings of the forest departments belonging to the host states/union territories. Yet, the jurisdiction of these marine parks falls under the state as well as the central authorities, depending on the criticality and scale of endangerment of the demarcated zone. This has resulted in a lack of coordination between the legislative bodies (the proponents of conservation measures) and the on-the-field management agencies (the ones who implement these measures). The sorry state of affairs, hence, is a virtually non-existent policy for the conservation and management of coral reefs.

Taking cue from the shortcomings in bridging the gap between policy planning and implementation, it is high time that a single national policy is devised to bring the holistic management of corals under one centralised authority – albeit carried out through franchise agencies under its overall jurisdiction. Not only should there be tie-ups with several likeminded NGOs on the ground, but there should also be an impetus towards strengthening the scientific base by absorbing more marine biologists. The pooling in of the findings of coral-related marine scientific expeditions needs to be effectively compounded with the framing of conservation mechanisms, on the basis of the collected data. The need of the hour is to keep checks and balances on any development-oriented activity (for example, dredging and discharge from oil refineries) that invariably contributes to the degradation of coral habitats. Just as much as the destruction of rain forests have sparked debates worldwide about the imminent threat it poses to global climate change, coral destruction ought to be given the same priority, especially with regard to its inevitable role in regulating environmental disruptions.

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